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Detection of Snow Conditions in Mountainous Terrain

Donald R. Wiesnet, NOAA

SUMMARY

Snowline Determination

ERTS-1 imagery of the Cascade Mountains in Washington taken during orbit 70, July 28, 1972, clearly shows the snowline in the Cascade Mountains. Using the next frame of this orbit, the snowline elevation on Mt. Rainier was found to range from 5100' to 5800' above msl in four different sectors with an overall average of 5500' msl. The U.S. Geological Surbey's glaciologists in Tacoma, Wash., give a mean firn line on Mt. Rainier at 6000' msl. The snowline in July ranges from 5,000' to 10,000'. This year's record snowpack would make 5500' a very reasonable figure.

Although the ERTS revisit time is unsatisfactory to most hydrologists, the resolution of ERTS-1 MSS imagery is sufficient for determining snowline elevation in mountainous terrain for all but the most stringent hydrologic requirements.

Melting Snow Detection

Previous studies of the differential spectral reflectance of melting snow and ice using Nimbus III HRIR data indicate that melting snow reflects less energy in the near-IR range than in the visible range of the spectrum. Preliminary examination of ERTS-1 MSS imagery from the Cascade Mountains of Washington as well as from British Columbia in Canada tentatively confirm this finding.

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Imagery from orbit 70 (July 28, 1972) is shown in black and white (figure 1) and in simulated natural color, bands 4-7 (figure 2). Enlargements prepared by NESS (figures 3, 4) were prepared from the extreme northwestern part of this ERTS-1 70 mm. chip. Only band 4 (.5-.6μm) is shown in figure 3. Snow-capped Mt. Eldorado (8868') lies in the northeast corners. The snow area south it it includes Snowking Mountain (7438') and Spirepeak Mountain (8261').

Comparing the .5-.6μm band with the .8-1.1μm band reveals that snow reflectance is greatly reduced in the near IR (.8-1.1μm) except in the Spirepeak area, indicating that melting snow conditions prevail. The same effect is clearly seen in orbit 42 (July 27, 1972) imagery of the Revelstone area of British Columbia. The air temperatures in the Cascade area ranged from 60-85°F (1000 PST.). Rawinsonde 700-millibar charts place the 10,000' level temperatures near 11°C, in Oregon and -3°C in northern British Columbia.